

**A Species Action Plan for the
Florida Mouse
*Podomys floridanus***

**Final Draft
November 1, 2013**



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EXECUTIVE SUMMARY

The Florida mouse (*Peromyscus floridanus*) is a relatively large mouse found only in peninsular Florida where it inhabits dry (xeric) uplands. Although many different types of mice live in Florida, from the rare beach mouse (*Peromyscus polionotus* ssp.) to the common cotton mouse (*Peromyscus gossypinus*), the Florida mouse is unique among rodents found in Florida. This species is considered a commensal of the gopher tortoise (*Gopherus polyphemus*), as it often constructs its burrow within the tortoise burrow. Although range-wide population data for the Florida mouse are not available, models of potential habitat suggest that a decline has occurred. This plan addresses the need for better information regarding the population status, habitat requirements, and threats facing the Florida mouse. The Florida mouse Biological Review Group conducted a biological assessment of available information and concluded that the species does not meet any of the criteria for listing. As a result, the Florida Fish and Wildlife Conservation Commission recommended removing the Florida mouse from the state's list of Species of Special Concern.

The goal of this plan is that the conservation status of the Florida mouse remains the same or is improved so that the species does not warrant listing on the Florida Endangered and Threatened Species List. Objectives include maintaining a statewide population that is stable or increasing, while addressing potential threats to the viability of local populations. The second objective is to identify the characteristics of high-quality habitat for the Florida mouse so that land management practices (including prescribed fire) improve species conservation. The last objective involves determining the genetic structure and genetic connectivity throughout the species' range.

This plan details the actions necessary to improve the conservation status of the Florida mouse. A summary of this plan will be included in the Imperiled Species Management Plan (ISMP), in satisfaction of the management plan requirements in Chapter 68A-27, F.A.C., Rules Relating to Endangered or Threatened Species. The ISMP will address comprehensive management needs for 60 of Florida's imperiled species and will include an implementation plan; rule recommendations; permitting standards and exempt activities; anticipated economic, ecological, and social impacts; projected costs of implementation and identification of funding sources; and a revision schedule. The imperiled species management planning process relies heavily on stakeholder input and partner support. This level of involvement and support is also critical to the successful implementation of the ISMP. Any significant changes to this plan will be made with the continued involvement of stakeholders.

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GLOSSARY OF TERMS AND ACRONYMS

Area of Occupancy: The area within its extent of occurrence (see Extent of Occurrence), which is occupied by a taxon, excluding cases of vagrancy. This reflects the fact that a taxon will not usually occur throughout the area of its extent of occurrence, which may contain unsuitable or unoccupied habitats (as defined by International Union for Conservation of Nature [IUCN]).

BRG: Biological review group, a group of taxa experts convened to assess the biological status of taxa using criteria specified in Rule 68A-27, Florida Administrative Code, and following the protocols in the Guidelines for Application of the IUCN Red List Criteria at Regional Levels (Version 3.0) and Guidelines for Using the IUCN Red List Categories and Criteria (Version 8.1).

BSR: Biological status review report, the summary of the biological review group's findings. Includes a Florida Fish and Wildlife Conservation Commission (FWC) staff recommendation on whether or not the species status meets the listing criteria in Rule 68A-27.001, Florida Administrative Code. These criteria, based on IUCN criteria and IUCN guidelines, are used to help decide if a species should be added or removed from the Florida Endangered and Threatened Species List. In addition, FWC staff may provide within the report a biologically justified opinion that differs from the criteria-based finding.

Commensal: An organism living in a relationship in which 1 animal derives food, refuge, or other benefits from another animal without hurting or helping the other animal.

Endemic: Found only in a particular locality or region.

Extent of Occurrence (EOO): The geographic area encompassing all observations of individuals of a species, including intervening areas of unoccupied habitat. Synonymous with range. See also Area of Occupancy (as defined by IUCN).

F.A.C.: Florida Administrative Code. The Department of State's Administrative Code, Register and Laws Section is the filing point for rules promulgated by state regulatory agencies. Agency rulemaking is governed by Chapter 120, Florida Statutes, the Administrative Procedures Act. Rules are published in the Florida Administrative Code.

FNAI: The Florida Natural Areas Inventory, a non-profit organization administered by Florida State University and dedicated to gathering, interpreting, and disseminating information critical to the conservation of Florida's biological diversity.

FWC: The Florida Fish and Wildlife Conservation Commission, the state agency constitutionally mandated to protect and manage Florida's native wildlife species.

GIS: Geographic Information System

GLOSSARY OF TERMS AND ACRONYMS

Habitat: The area used for any part of the life cycle of a species (including foraging, breeding, and sheltering).

Incidental Take: Any taking otherwise prohibited, if such taking is incidental to, and not the purpose of the carrying out of an otherwise lawful activity. (as defined in Rule 68A-27.001(5), F.A.C).

ISMP: Imperiled Species Management Plan

IUCN Red List: (IUCN Red List of Threatened Species) An objective, global approach for evaluating the conservation status of plant and animal species, the goals of which are to: Identify and document those species most in need of conservation attention if global extinction rates are to be reduced; and provide a global index of the state of change of biodiversity.

LAP: Landowner Assistance Program, a federal cost-share program administered in Florida by the FWC.

Local Population: A group of individuals within an area smaller than the geographic range of the species and often within a population.

Metapopulation: A group of spatially separated populations of the same species that interact at some level.

Natural Community: A distinct and reoccurring assemblage of populations of plants, animals, Fungi, and microorganisms naturally associated with each other and their physical environment.

Phylogeography: A discipline in biology concerned with principles and processes governing the observed geographical distribution of genetic variation within and between populations or species. Inference of population structure, which is a reflection of divergence among populations, is at the core of phylogeographic studies.

Population: The total number of individuals of the taxon. Population numbers are expressed as numbers of mature individuals only (as defined by IUCN).

Predation (Depredation, predated): to be killed or destroyed by a predator.

Scientific Collecting Permit: A permit issued for activities that include salvage, voucher, bird banding, wildlife possession, or special purpose. Applications must demonstrate a scientific or educational benefit for the species, and must identify the purpose, scope, objective, methodology, location, and duration of the project.

Subpopulation: Geographically or otherwise distinct groups in the population between which there is little exchange.

GLOSSARY OF TERMS AND ACRONYMS

Take: As defined in 68A-1.004 F.A.C. (General Prohibitions) “Taking, attempting to take, pursuing, hunting, molesting, capturing, or killing any wildlife or freshwater fish, or their nests or eggs by any means whether or not such actions result in obtaining possession of such wildlife or freshwater fish or their nests or eggs.”

URTD: Upper respiratory tract disease

Viable Population: A population that has a very high probability (e.g., 90 to 95%) of persisting for a long-term period (e.g., 100 years into the future) without a significant loss in genetic diversity, or while meeting other measures of viability that may be specified on a case-by-case basis.

WCPR: Wildlife Conservation, Prioritization, and Recovery. A program administered by the FWC on FWC-managed areas to ensure that protected lands are managed for the highest benefit of wildlife.

WMA: Wildlife Management Area

Xeric (community): An area with soils that are typically dry or low in moisture. Xeric communities are characterized by dry, sandy soils that are often nutrient poor, with limited water availability.

INTRODUCTION

Biological Background

Taxonomy

The Florida mouse (*Podomys floridanus*) is endemic to Florida. Previously classified in the genus *Peromyscus*, the subgenus *Podomys* was elevated to full genus status in 1980 (Carleton 1980). Similar to the Florida scrub-jay (*Aphelocoma coerulescens*), gopher tortoise (*Gopherus polyphemus*), eastern indigo snake (*Drymarchon couperi*), and other inhabitants of Florida's xeric natural communities, the nearest relatives of the Florida mouse can be found in the western Americas (Layne 1990).

Description

The Florida mouse has relatively large ears, eyes, and hind feet. The Florida mouse is also characterized by the presence of only 5 (sometimes 4 and rarely 6) plantar tubercles on the soles of the hind feet, instead of the 6 plantar tubercles typical of the genus *Peromyscus* (Figure 1). Adults' pelage is brown or tawny on top, with white undersides and orange-buff colored fur on the cheeks, shoulders, and lower sides. Adults also have a relatively large body size, weighing between 20 and 49 g (0.7 and 1.7 oz) (Layne 1990, Layne 1992, Jones and Layne 1993, Whitaker and Hamilton 1998).

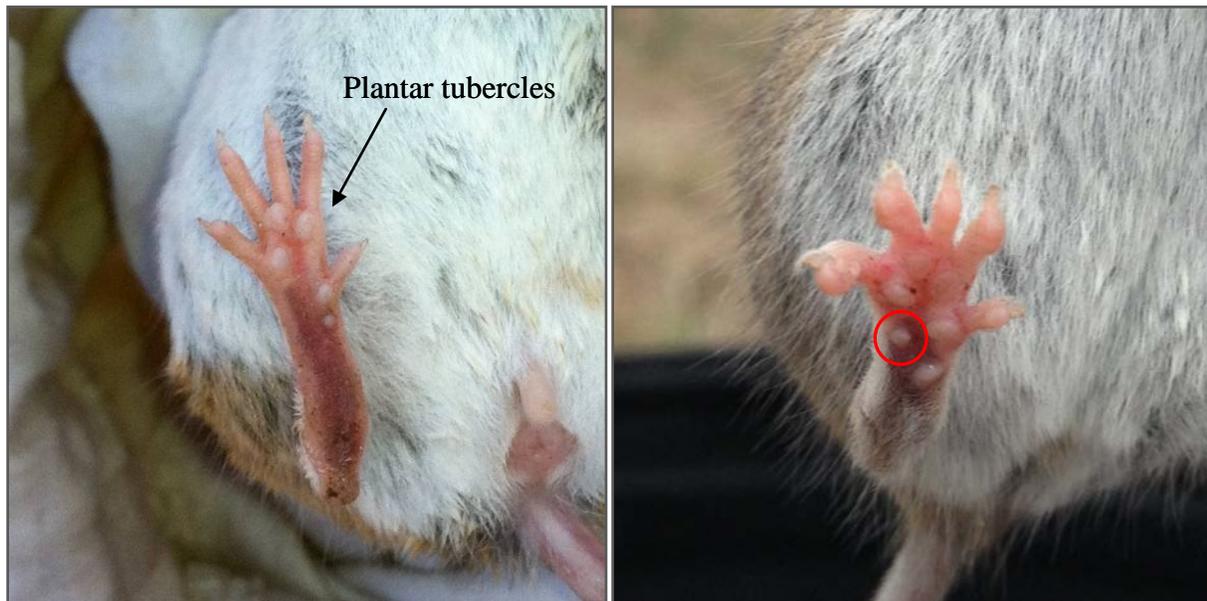


Figure 1. Rear foot of a Florida mouse (left), and a cotton mouse (right), showing the plantar tubercles (pads) on the bottom of each. The circle highlights the sixth tubercle on the foot of the cotton mouse that is not present on the foot of the Florida mouse. Photographs by Travis Blunden (left) and Anni Mitchell (right).

Reproduction and survivorship

Reproduction occurs throughout the year but peaks in fall and in winter. Litters typically consist of 2 to 4 young, and offspring wean at 3 to 4 weeks. Mean survival time for adults (as recorded during trapping studies) was reported as being longer in sandhill (4.2 months) than in scrub (2

months) (Layne 1990). However, survivorship of more than 360 days was reported in 8.6% of 1 local population (Jones 1990).

Diet

Florida mice consume a wide range of food items including acorns, insects, seeds, nuts, fungi, and other plant material. Given the range of food they consume, Florida mice are probably opportunistic feeders (Jones 1993). Food resources are important in determining habitat quality. However, Florida mice are dependent upon the presence of acorns as a major component of the diet (Layne 1990, 1992; Jones 1990, 1993).

Habitat use and home range size

Florida mice are largely restricted to fire-maintained, xeric, upland communities with deep, well-drained, sandy soils. The primary natural communities occupied by the Florida mouse are scrub (includes scrubby flatwoods, oak scrub, sand pine scrub, and rosemary scrub) and sandhill, though the species can often be found in drier mesic flatwoods and has been recorded in a number of other natural communities such as flatwoods, hammocks, and wetland edges during dispersal (Layne 1990). Ground cover may be sparse, especially in scrub, but the number of Florida mice in a sandhill may be correlated with ground cover diversity (T. Doonan, Florida Fish and Wildlife Conservation Commission [FWC], personal communication).

Florida mouse populations may be isolated and scattered because the distribution of their primary habitats is often discontinuous (Layne 1990). Habitat loss and degradation exacerbate this problem as the already discontinuous habitat becomes increasingly fragmented. This creates problems with demographic connectivity.

Florida mice excavate burrows that they use as daytime refuges and as nesting sites, with expanded nesting chambers usually present (Layne and Jackson 1994). They typically build their burrows inside the burrows of other species, often in gopher tortoise burrows. Florida mice burrows are typically found as small U-shaped tunnels off the sides of the main gopher tortoise burrow. Florida mice use gopher tortoise burrows ([Figure 2](#)) for shelter and protection and as cover from fire and adverse weather conditions (Layne 1990). The Florida mouse can be sensitive to cold temperatures and begins to show signs of cold stress at 10° C (50° F) (Jones 1990). For these reasons, the ecology of the Florida mouse is considered to be tightly linked to the gopher tortoise (Jones and Layne 1993). This association leaves the Florida mouse vulnerable to gopher tortoise population decline. However, Florida mice will use burrows of other species such as the nine-banded armadillo (*Dasypus novemcinctus*) and old-field mouse (*Peromyscus polionotus*). They also opportunistically use stump holes or other holes, especially in scrub (Jones 1990, Layne 1990, 1992; Lips 1991, Jones and Layne 1993, Layne and Jackson 1994;).

Home ranges of the Florida mouse tend to be smaller in scrub than in sandhill, which may be a function of greater resource abundance in scrub (Layne 1990). Scrub habitat generally supports higher numbers of Florida mice than does sandhill. Reported density estimates have ranged from 1.6 ha to 28 ha (0.64 to 11.2 ac) and average around 5 to 10 ha (2 to 4 ac) depending on the location and community type (Layne 1992). Jones (1990) reported that in sandhill, females had a home range size of 2,601 m² (0.64 ac), while males had an average home range of 4,042 m² (1 ac).

Geographic Range and Distribution

The Florida mouse occurs only in a narrow range of dry, natural communities in the northern 2/3 of peninsular Florida (Fertig and Layne 1963, [Figure 3](#)). In the north-central peninsula, the species' extent of occurrence (EOO) stretches through Clay, Suwannee, and Taylor counties, and then south to Sarasota County on the west coast (although it has not been documented in Sarasota County in recent years), and south to Highlands County in central Florida. Along the Atlantic coast, a separate area of the EOO extends from St. Johns County south to Palm Beach County (formerly, south to Dade County) (Layne 1992, Jones and Layne 1993, Pergams et al. 2008). Historically, an isolated Florida mouse population occurred near Carrabelle in Franklin County (Layne 1992, Jones and Layne 1993; [Figure 3](#)). A cursory survey for the Florida mouse at Carrabelle carried out by Florida Natural Areas Inventory (FNAI) in 2001 proved unsuccessful (D. Hipes, FNAI, personal communication). Although the Florida mouse probably no longer occurs on the coast of Pinellas County, a single specimen was captured in 1984 near Clearwater (Layne 1992). North-central peninsular Florida appears to contain the largest, most contiguous patches of habitat occupied by the Florida mouse. In the southern peninsula, the Florida mouse is largely restricted to the Lake Wales Ridge in the central region and to a very narrow strip along the east coast (Layne 1992).



Figure 2. A typical gopher tortoise burrow in open sandhill. Gopher tortoise burrows are used by Florida mice. Photograph by Terry Doonan, Florida Fish and Wildlife Conservation Commission.

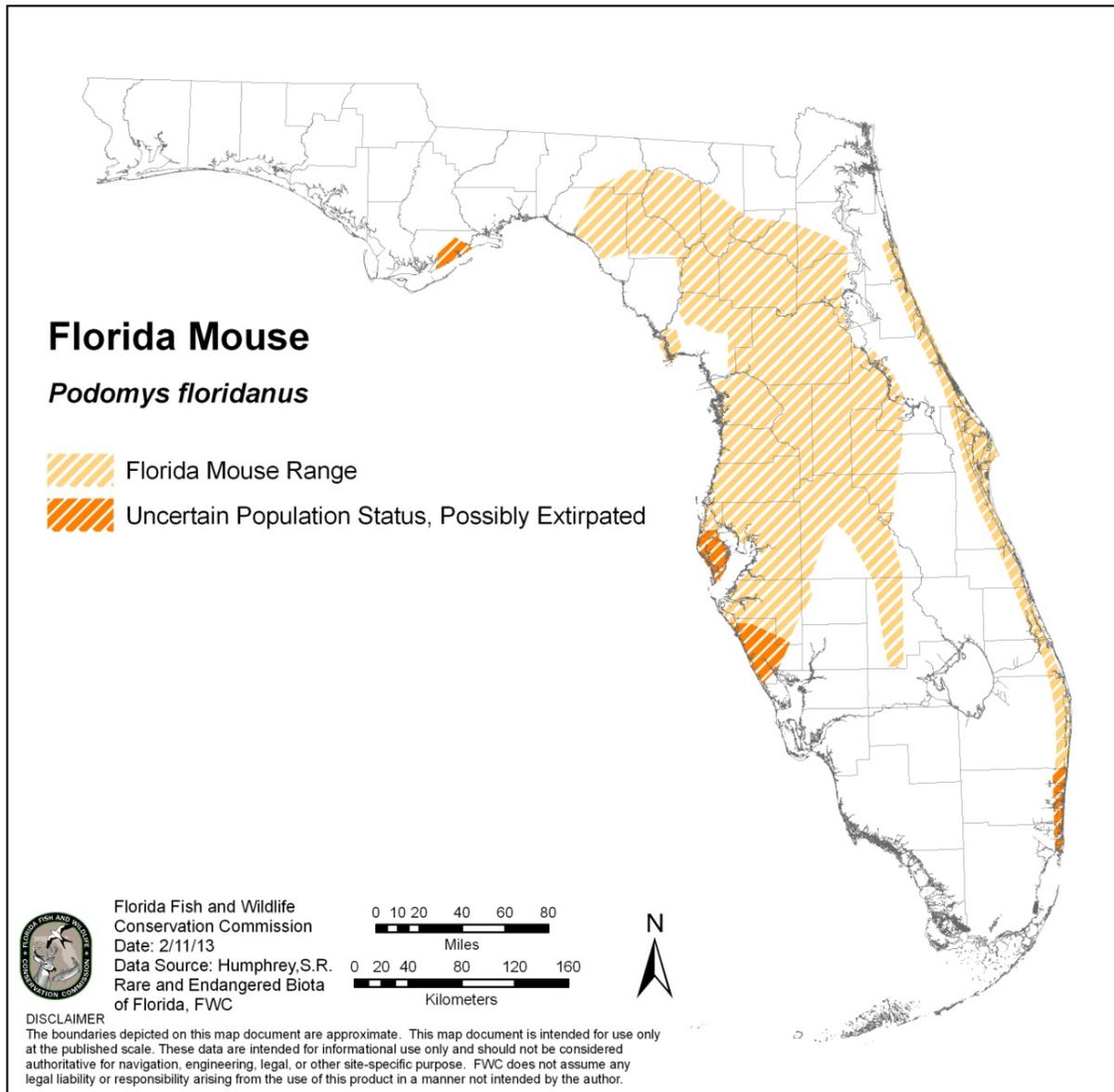


Figure 3. The historical extent of occurrence (EOO) of the Florida mouse, adapted from Layne (1992). Within the EOO, the Florida mouse is limited to patches of xeric, upland communities. Those patches are discrete, often small, and do not occur in all parts of the EOO.

Within the EOO, habitat that is potentially suitable for the Florida mouse is not continuous. Xeric, upland communities generally are present in discrete, often small, patches that do not occur in all parts of the EOO. Cox and Kautz (2000) and Endries et al. (2009) conducted 2 recent geographic information system (GIS) analyses of potential habitat for the Florida mouse. Cox and Kautz (2000) reported that an estimated 339,100 ha (837,916 ac) of potential habitat existed, of which approximately 41.5% occurred on managed lands. Endries et al. (2009) reported that >278,000 ha (>686,938 ac) of potential habitat existed, of which 53% occurred on managed lands. The authors defined *managed lands* as public and private lands managed for conservation (see Endries et al. 2009). Differences between the results of these studies suggest that potential habitat for the Florida mouse may have declined 18% between 2000 and 2009 (Cox and Kautz

2000, Endries et al. 2009). However, those results also indicate the area of potential habitat on managed lands increased by 4.7% over that time period. Note that interpretation of these results is complicated and weakened by the fact that these GIS analyses used different methodologies and different Landsat models. Even so, comparing the results from these two analyses has been the best option for assessing changes in the availability of potential habitat over time.

Conservation History

While there have been a limited number of conservation actions taken specifically for the Florida mouse, the species has also benefitted greatly from conservation actions taken for the benefit of the gopher tortoise. The Florida mouse is a commensal of the gopher tortoise (Jones 1990, Jones and Franz 1990, Layne 1990, 1992; Layne and Jackson 1994, Schmutz 1997), and management efforts to maintain viable tortoise populations have benefitted the Florida mouse. Some habitat resource needs of the Florida mouse (e.g., some food resources) overlap those of the gopher tortoise. Further, Florida mice construct their burrows within tortoise burrows (Jones and Franz 1990, Layne 1992, Layne and Jackson 1994). Conservation actions taken for Threatened and Endangered species such as the Florida scrub-jay and red-cockaded woodpecker (*Picoides borealis*) have also contributed to the conservation of the Florida mouse.

Habitat acquisition and protection is a key priority of FWC's gopher tortoise management plan (FWC 2012), which also benefits commensal species such as the Florida mouse: "Habitat protection has been and continues to be an important element of FWC's conservation strategy for [the gopher tortoise]. Past land acquisition efforts by FWC and other state agencies have focused on securing highquality natural communities because of the values these habitats provide to tortoises, burrow commensals, and other wildlife species... The [2012] revision of the FWC gopher tortoise management plan includes a new approach to habitat protection through incentives and partnerships... Protection of quality native habitats will continue to be a priority, but restoration of potential habitat for gopher tortoises on public and private lands will also take priority when these activities contribute toward recovery of the gopher tortoise" (FWC 2012).

In the 1980s, the Florida Game and Fresh Water Fish Commission (predecessor of the FWC) developed a mitigation program to offset loss of gopher tortoise habitat. The Mitigation Park program identified populations of tortoises and targeted land acquisition around those populations. Before the Mitigation Park program was discontinued, 14 tracts totaling 6,200 ha (15,320 ac) were acquired. Although commensal species were not considered in determining acquisition priorities, Florida mice have been documented on several mitigation parks, demonstrating that the program contributed real benefits to the conservation of the Florida mouse. Overall, the State of Florida has implemented a variety of land acquisition and conservation programs including, most recently, the Florida Forever Program established in 1999. Between 2001 and 2011, the Florida Forever Program funded the acquisition of approximately 213,250 ha (526,950 ac) of upland conservation lands (FWC 2012).

Management to increase the quality of suitable habitats has been the recommended focus for conservation of viable Florida mouse populations (Layne 1990). On many sites occupied by Florida mice, the quality of the habitat has become degraded by a lack of effective management, as well as by disturbance and fragmentation (Layne 1992). To help address management problems, the Florida mouse has been identified as a focal species in FWC's Wildlife

Conservation, Prioritization and Recovery program (WCPR). Through the WCPR, management strategies designed to improve habitat quality for the Florida mouse are provided to managers of conservation lands with potentially suitable habitat.

Threats and Recommended Listing Status

Threats

The Florida mouse does not meet any criteria for listing; however, there are ongoing threats that may affect the Florida mouse in the future. The Florida mouse depends on fire-maintained, xeric uplands occurring on deep, well-drained soils, especially scrub and sandhill (Jones and Layne 1993). Because of this habitat specificity, the major threat to the Florida mouse is loss and degradation of habitat caused by conversion to other uses (e.g., development and agricultural use) and insufficient management (e.g., fire suppression) (Layne 1990, 1992). For example, in Highlands County, 64% of the species' habitat was destroyed between 1940 and 1980, with an additional 10% considered disturbed or degraded (Layne 1992).

Historically, the distribution of sandhill and scrub communities in Florida was naturally fragmented and discontinuous (Myers 1990). Unfortunately, these communities are becoming increasingly fragmented (Layne 1992). The result is that Florida mouse populations are becoming more isolated, with reduced movement of individuals among populations a predicted consequence (Layne 1992). Effects of such increased isolation can be more frequent loss or extirpation of local populations and reduced gene flow within or among populations (Hilty et al. 2006).

Dependence of Florida mice on gopher tortoise burrows as sites for their own burrows (Jones and Layne 1993) leaves Florida mice vulnerable to the decline of gopher tortoises in some habitats. Some research has estimated that the gopher tortoise populations in Florida have declined 50% to 60% over the past 60 to 93 years (Enge et al. 2006). The International Union for Conservation of Nature (IUCN) stated, "*Podomys floridanus* is moderately dependent on gopher tortoise burrows (Pergams et al. 2008), and gopher tortoises in Florida are well documented to be in decline, as much as 80% by some estimates due to habitat destruction as well as Upper Respiratory Tract Disease (URTD)." However, most of the estimated gopher tortoise declines associated with habitat loss occurred prior to the last 10 years (Cox and Kautz 2000, Enge et al. 2006, Endries et al. 2009). Further, Berish et al. (2010) reported that while URTD may be chronic in many gopher tortoise populations, mortality is typically low and rarely results in local extinctions that would have a negative effect on Florida mouse populations.

There are some concerns that relocation of Florida mice, which currently is allowed in limited circumstances under permitting provisions in FWC's Gopher Tortoise Permitting Guidelines (FWC 2013) ([Appendix 2](#)), may have unintended consequences on local populations of Florida mice. Previous versions of the gopher tortoise permitting guidelines provided little guidance on relocations, and the current limitations are a result of concern over the potential impacts. Both the Gopher Tortoise Management Plan (FWC 2012) and the current permitting guidelines recognize that additional data are needed to evaluate the potential benefits of relocations, relative to potential negative impacts to Florida mouse populations.

Insufficient or inappropriate habitat management also can threaten the Florida mouse. This species shows a preference for early successional habitats maintained or created by fire. The availability of these habitats declines as natural and prescribed fires are suppressed (Hafner et al. 1998). This could be problematic on private lands, where prescribed fire return intervals may be longer than is required to maintain the habitat quality necessary for robust Florida mouse populations. However, for managed conservation lands across regions of the state occupied by the Florida mouse, Debra Childs Woithe, Inc., and PBS&J (2010) recently estimated that only 37% to 61% of sandhill and 15% to 50% of scrub currently meet management targets for fire-return intervals. The manner in which this criterion is used may be of further concern because fire-return intervals are at best indices of habitat quality and target intervals are not consistent among agencies.

A number of species prey upon Florida mice, including several snakes, foxes (*Urocyon cinereoargenteus* and *Vulpes vulpes*), raccoons (*Procyon lotor*), and bobcats (*Lynx rufus floridanus*) (Layne 1992, Jones and Layne 1993). Some of these predators benefit from close association with people, which may increase the threat of predation to Florida mice as habitats become fragmented and natural areas are increasingly interspersed with developed areas. Red imported fire ants (*Solenopsis invicta*) may be a predatory threat to the Florida mouse (Wetterer and Moore 2005). Free-ranging domestic cats (*Felis catus*) may be another introduced predator (Loss et al. 2013).

Impacts from climate change may produce further challenges for the conservation of the Florida mouse. However, adaptation of management strategies to those changes will require an understanding of projected influences to the natural communities and ecological systems on which the Florida mouse depends. At this time, potential impacts from climate change are not well understood; therefore, identification of appropriate management strategies is not readily possible (Dubois et al. 2011). The vulnerability of Florida mouse populations to climate change will depend on the degree to which the Florida mouse is likely to experience harm from stressors produced by changes in large-scale climatic drivers (Intergovernmental Panel on Climate Change [IPCC] 2007, Dubois et al. 2011). Vulnerability will be a result of multiple variables including the intensity and duration of the climate changes, the innate sensitivities of the Florida mouse to those changes, and, ultimately, the capacity of the Florida mouse to adapt to the changes that occur (IPCC 2007, Dubois et al. 2011). A vulnerability assessment could be conducted to help identify the potential effects to the Florida mouse from projected climatic changes and thus to better inform decision-making processes used to identify and prioritize conservation strategies for the Florida mouse (Dubois et al. 2011, Glick et al. 2011). Supporting a healthy Florida mouse population by protecting and improving habitat across its range could help the species better adapt with climate change.

Recommended Listing Status

In 2010, FWC directed staff to evaluate the status of all species listed as Threatened or Species of Special Concern that had not undergone a status review in the past decade. To address this charge, staff conducted a literature review and solicited information from the public on the status of the Florida mouse. The FWC convened a biological review group (BRG) of experts on the Florida mouse to assess the biological status of the species using criteria specified in Chapter 68A-27.001, Florida Administrative Code (F.A.C.). This rule includes a requirement for BRGs to

follow the Guidelines for Application of the International Union for Conservation of Nature (IUCN) Red List Criteria at Regional Levels (Version 3.0) and Guidelines for Using the IUCN Red List Categories and Criteria (Version 8.1). FWC staff developed an initial draft Biological Status Review report (BSR), which included the BRG's findings and a preliminary listing recommendation from staff. The draft was sent out for peer review, and the reviewers' input was incorporated into a final [report](#).

The FWC's Florida mouse BRG concluded from their biological assessment that the Florida mouse did not meet listing criteria. As a result, the FWC recommended that the Florida mouse be removed from the state's list of Species of Special Concern under Rule 68A-27, F.A.C.

CONSERVATION GOALS AND OBJECTIVES

Goal

The conservation status of the Florida mouse remains the same or has improved so that it does not warrant listing on the Florida Endangered and Threatened Species List.

The Florida mouse did not meet any criteria for listing during the [BSR](#) process; however, there are ongoing threats that may affect the Florida mouse in the future. Therefore, this goal is proposed with the recognition that the Florida mouse has narrow preferences for fire-maintained, xeric communities. The loss and fragmentation of those communities is expected to continue. Additionally, across the range of this species, subpopulations may be small, their status is not well known, and they may be isolated from other conspecific subpopulations. These conditions enhance the potential for local extirpations. Further, effective habitat management is essential to maintain habitat of sufficient quality to sustain a secure, viable Florida mouse population.

Objectives

I. Ensure the statewide population of the Florida mouse is stable or increasing.

Rationale

Estimated population levels and trends (decline of 18%, with 30% needed to trigger listing) used in the [BSR](#) were based on the availability of potentially suitable habitat. These estimates have a high level of uncertainty, and research is needed to address this uncertainty and improve the ability to obtain meaningful population estimates. There is also a need to understand the genetic structure of the Florida mouse population in order to understand the potential impact of habitat fragmentation on genetic connectivity. This knowledge will, in turn, inform us about long-term population viability. To achieve the conservation goal for this species, it is important to avoid or minimize further isolation of local populations and maintain or increase the statewide population. While the number of individuals within subpopulations may fluctuate, the overall statewide population should be monitored in a way that detects potential threats to the viability of local populations. Reliable and effective management techniques combined with development of improved population estimation tools will make it possible to ensure the statewide population is stable even when unpredicted events may produce localized declines in some subpopulations.

II. Understand the characteristics of high-quality habitat for the Florida mouse and incorporate into management objectives for scrub and sandhill.

Rationale

Sandhill and scrub are primary, optimal habitats for Florida mice, but not enough is known about vegetative composition or diversity and how they are related to high-quality habitat for Florida mice. Past research (Schmutz 1997) found interesting relationships between the presence of burrows and vegetative structure, but limited sample size, duration, and habitat types make it difficult to apply the results across Florida mouse populations statewide. It is also important to consider other non-vegetation parameters, such as abundance of gopher tortoise burrows, competing species, and predator densities.

There can be variations in the use of prescribed fire and other habitat management methods used in scrub and sandhill communities. Often the objective is to improve the habitat for 1 or more high-profile listed species (e.g., Florida scrub-jay, gopher tortoise, and red-cockaded woodpecker), and it is assumed that other species such as the Florida mouse also will benefit. This assumption may not be correct if specific habitat parameters required for viable Florida mouse populations are not maintained.

For the Florida mouse to be effectively conserved in Florida, it is essential that scrub and sandhill communities on public and private conservation lands be managed to support a viable population of Florida mice throughout the species' distribution (its EOO). The BRG identified the need to set habitat management criteria that are more directly linked to high-quality habitat for the Florida mouse as imperative for ensuring that habitat degradation does not occur. Establishing management objectives based on vegetative composition (vegetative diversity and the presence of oaks [*Quercus* spp.] and other key food resources) would be a more effective approach than use of habitat structure. Habitat management objectives can greatly affect habitat quality, which will have strong effects on Florida mouse population demographics. However, it is also important to recognize that suboptimal habitats may hold value for Florida mouse populations (e.g., for corridors), although that value is not well understood. Knowledge of preferred and optimal habitat characteristics will aid land managers in meeting the needs of this species. Properly informed managers can play an active role in ensuring the status of the Florida mouse remains the same or improves.

III. Understand the status and degree of genetic connectivity among subpopulations and maintain phylogeographic structure of the population across its geographic range.

Rationale

There is a need to understand the existing genetic structure of the Florida mouse range-wide and the extent of historical connectivity among lineages. It is possible the statewide population is composed of distinct genetic lineages. This knowledge will inform us about the historical patterns of connectivity and allow for prioritization for management decisions (e.g., identifying lineages under greatest pressures from habitat loss). Further, there is a need to maintain or restore connectivity, as determined by the movement of individuals among local populations within each subpopulation. Isolated populations experience higher rates of local extirpation and reduced rates of re-colonization, resulting in a declining population and reduced area of occupancy.

CONSERVATION ACTIONS

The following sections describe the conservation actions that will make the greatest contribution toward achieving the conservation objectives. Actions are grouped by category (e.g., Habitat Conservation and Management, Population Management). The Conservation Action Table ([Table 1](#)) provides information on action priority, urgency, potential funding sources, likely effectiveness, identified partners, and leads for implementation.

Habitat Conservation and Management

Florida mice occupy upland, xeric communities (Layne 1992) typically described as scrub and sandhill (high pine) ecosystems (Myers 1990) ([Figure 7](#)). The term *scrub* is used to refer collectively to several natural communities including xeric oak scrub, sand pine (*Pinus clausa*) scrub, rosemary (*Ceratiola ericoides*) scrub, and scrubby flatwoods (Myers 1990). According to Layne (1990), “Scrub-type vegetation is the primary and ancestral habitat of the Florida mouse.” Both scrub and sandhill are fire-dependent ecosystems that require intermittent fires to maintain optimal habitat quality (Myers 1990). Fire-maintained scrub and sandhill communities typically support the highest densities of Florida mice (Layne 1990, 1992). We know the primary habitat of the Florida mouse consists of scrub and sandhill; however, there are uncertainties as to the characteristics of these favored by the Florida mouse ([Action 11](#)). We do know that because Florida mice are opportunistic omnivores, they utilize a variety of food resources, and we expect them to benefit from a diversity of plant species.

Action 1 Manage conservation lands with suitable habitat for the Florida mouse to promote a stable gopher tortoise population and a mosaic of conditions that includes a diversity of plants, including oaks.

While the gopher tortoise can be found in the same natural communities, and its burrows are an important feature for the Florida mouse, it does not necessarily share the same preference in vegetation parameters. The seasonal dependence on acorns in addition to their diet of seeds, insects, and other plant material makes their preferences more similar to the Florida scrub-jay. Maintaining a variety of oak species for mast production and cover is important for the Florida mouse (Layne 1990).

In fire-maintained communities such as sandhill, hardwood encroachment can become a problem when fire has been absent for long periods of time. In some restoration efforts, sometimes all hardwoods, including oaks, are removed or killed on large areas. This complete removal of oaks should be avoided. It is important for the Florida mouse and other wildlife that some mast-producing trees remain when hardwoods control is a management objective. In the future, with the quantification of habitat preferences of Florida mice ([Action 11](#)) and their response to management activities ([Action 10](#)) better guidance will be available for land managers.

Action 2 Maintain functional metapopulations of Florida mice.

Small, isolated patches of xeric communities may support local subpopulations of Florida mice. Scrub in particular is heavily fragmented and at the same time able to support the highest densities of Florida mice. In some regions there may be no large habitat patches. It is possible that Florida mouse subpopulations function as metapopulations and therefore connectivity of

these smaller parcels may determine their sustainability. For this reason, there may be benefits to protecting existing corridors and creating new corridors to link patches together in order to promote dispersal to them. Mapping and analysis with GIS tools could be used to identify small patches that have potential for connection to other patches of suitable habitat. Because small patches of habitat may contain a significant proportion of the Florida mouse population, maintenance of functional metapopulations will ensure re-population of local habitats when local populations blink out. Metapopulations are assumed to undergo extirpation-dispersal rescue events as part of the normal dynamics of such populations.

Population Management

This plan does not propose extensive species-specific population management. Subpopulations of Florida mice can be found where habitat conditions are favorable. The conservation and management of suitable habitat is the most immediate need. At this time actions like translocation or supplemental feeding are not required. Currently, Florida mice can be relocated in association with a permitted gopher tortoise relocation. There is no published information concerning the benefits of these movements or the possible negative impacts. This is addressed in [Action 3](#).

Monitoring and Research

Many aspects of the Florida mouse habitat preferences and population status are poorly understood. The following research and monitoring actions are important to understand the distribution, habitat requirements, and the genetic structure of the populations. Knowledge of these issues is necessary to develop and implement a conservation management approach capable of preventing the need for future relisting.

Action 3 Determine whether relocation is an effective conservation strategy for the Florida mouse.

Relocation has been utilized as a means of mitigating take for sites where disturbance or loss of habitat occurs. Typically, Florida mouse relocations are proposed in association with the relocation of gopher tortoises. However, data are needed to determine whether relocation creates benefits or is an appropriate management tool for the Florida mouse. This action mirrors the action called for in FWC’s Gopher Tortoise Management Plan (FWC 2012) recognizes that there are no science-based guidelines for the translocation of the Florida mouse ([Appendix 1](#)). Additionally, the Gopher Tortoise Permitting Guidelines ([Appendix 2](#)) provide interim guidance on the translocation of Florida mice (FWC 2013).

Before relocation becomes accepted as an effective population management strategy for the Florida mouse, research should be conducted to evaluate potential negative impacts and demonstrate the benefits of that process. Possible negative impacts to evaluate should include survivorship of residents, displacement of residents, changes in reproduction rates, and changes in habitat use. Once such research is completed, FWC should work with stakeholders to evaluate the results, determine whether relocation should continue, and (if appropriate) modify relocation policies. If research indicates that relocations do not benefit the species, relocations should no longer be permitted even in a limited capacity as outlined in the current permitting guidelines.

Another consideration when evaluating policies related to relocation is the genetic, or phylogeographic, structure of the statewide Florida mouse population. Currently it is not known whether there are significant genetic differences among subpopulations across the range, or area of occupancy, of the Florida mouse. Research to measure genetic differences among (or within) subpopulations ([Action 7](#)) will be critical in the development of translocation guidelines.

Action 4 Develop and implement a survey protocol for determining the presence of Florida mice on conservation lands.

Currently, the only population data is inferred from models of potentially suitable habitat. The [BSR](#) findings are based on estimates of loss of suitable habitat, and peer reviewers pointed out that the different methods in determining suitable habitat could lead to an underestimation of habitat loss. Presence and absence surveys across the range give a better approximation and provide a measure of fit for the models. Presence and absence surveys would allow for a more accurate estimate of occupancy. In addition, defining the current extent of occupancy and distribution on conservation lands within the known range would be an important first step in developing a more accurate, predictive population model. A draft survey protocol has been developed as part of the WCPR program ([Appendix 3](#)). This protocol can be used in determining presence and occupancy modeling. Additional consultation with species experts and statisticians may be needed to assure that the collected data are sufficient to meet the goals of developing better predictive models.

Action 5 Develop predictive population models using optimal density estimates for Florida mice in each primary community type (i.e., sandhill, scrub, and scrubby flatwoods).

While there are several community types where Florida mice occur, they do not all support the same densities. To develop a predictive population model, an estimate of density within each community type needs to be made. While there are some published density estimates (see [Habitat use and home range size](#)) and modeling at specific sites (Schmutz 1997), these should be supplemented with data from multiple natural communities from various locations within the known range. Such estimates usually are developed through mark–recapture studies. These studies involve using live traps to capture Florida mice ([Figure 4](#)) that are then marked (usually with a numbered ear tag) and released; a follow-up trapping event determines the proportion of marked individuals. Statisticians should be consulted prior to any study to ensure the outcomes will be statistically valid. In addition, recording demographic information (e.g., age, class composition, and reproductive activity) may improve predictive modeling better than simple densities. This information combined with composition, condition, and structure of the habitat will help accomplish [Action 10](#). Density information in conjunction with presence and absence information from [Action 4](#) will allow for development of a predictive population model.

Action 6 Initiate a monitoring program for the Florida mouse on public lands.

While managers have conducted surveys on some managed lands, there remains little information on the status of Florida mouse subpopulations on many public conservation lands. The removal of the Florida mouse from the Florida Endangered and Threatened Species List is predicated on maintaining viable populations on those conservation lands that support sandhill

and scrub communities across the species' range. Monitoring is an essential population management effort to provide information on the current status and distribution of Florida mouse populations. The WCPR monitoring protocol ([Appendix 3](#)) is a possible approach for determining presence and absence of the Florida mouse. However, a subset of conservation lands (reference sites) should be monitored more thoroughly and systematically to better assess population size and trends over time, as well as provide data for population demographic assessments ([Action 5](#)). Coordination across agencies, among land managers, species experts, and statisticians is necessary to ensure data collected are sufficient for a statewide program to meet management goals. This monitoring program may provide valuable information that could be applied to evaluate the response of this species to climate change and other large-scale threats. Regular monitoring is necessary to determine population trends and assess the need for additional management actions.



Figure 4. Typical steps when conducting surveys for Florida mice include capture in Sherman's live traps (left) and handling the animal (right) to record necessary information. Photographs by Travis Blunden, FWC.

Action 7 Identify unique phylogeographic lineages within the statewide population and the geographic extent of each lineage.

Xeric communities are not evenly distributed in Florida and appear to be clustered in 4 discrete ridge systems: Atlantic Coastal Ridge, Lake Wales Ridge, Brooksville Ridge, and Ocala Ridge (includes the Mount Dora Ridge, Crescent City Ridge, and Marion Upland). Due to distances between these xeric systems, these ridge populations may be genetically differentiated. There is a need to understand the phylogeographic structure of the Florida mouse populations and the level of connectivity between these potentially distinct subpopulations. Previous work has shown that there are geographic differences in morphological characteristics that warrant investigation into the extent of genetic differentiation among subpopulations (Wolfe and Layne 1968). There are morphological and behavioral differences between Florida mice occupying sandhill and scrub communities that may have a genetic basis (Layne 1990).

There is a need to understand the connectivity within each subpopulation in order to prevent isolation of small, local populations. The movement of individuals among discrete local populations determines connectivity. An assessment of connectivity would be especially useful in areas where xeric communities are more fragmented, such as the Lake Wales Ridge and the

Atlantic Coastal Ridge. An understanding of genetic connectivity within subpopulations is an important component to any relocation policy ([Action 3](#)).

Biologists can easily collect tissue samples when surveying, with the least invasive method being to clip a very small portion from the top of one ear. The FWC could work with researchers at the University of Florida who are already undertaking some genetic work. The results may be used to delineate genetically distinct subpopulations. Knowing the genetic composition of the population will provide information needed to make sound recommendations for relocation guidelines ([Action 3](#)).

Action 8 Within each of the 5 major ridge systems, estimate population size and determine whether it is stable, increasing, or declining.

Population size and trend should be examined regionally. In order to protect Florida mice throughout the entire range, there should be large, stable populations within each ridge system.

Monitoring a limited number of selected sites or reference sites will be a cost-effective and practical approach to track the population's status and trend. In other areas, less intensive presence and absence monitoring will supplement monitoring done on core areas. The monitoring may be similar to that used by the WCPR program, after consultation with statisticians and species experts that the information obtained is sufficient to address the conservation goal.

In order to meet the objective of a stable or increasing statewide population, species' status on each ridge system should be known. Status determines if more direct habitat management for Florida mice ([Action 1](#)) is necessary or if relocation would be a useful management tool ([Action 3](#)).

Action 9 If the statewide population or any subpopulation is declining, investigate the causes of decline and implement activities to counter it.

In areas where a decline is detected, fecundity and adult survivorship should be measured and compared to stable subpopulations occupying high-quality habitat. This will require trapping efforts that are more intensive, and will likely include a mark-recapture component. Information gained through [Action 10](#) will be of great importance in determining if management activities alone can halt decline or if additional measures are required.

Action 10 Determine how current management practices (including fire) of scrub and sandhill influence Florida mouse populations.

Management of habitat to enhance quality will be a critical factor affecting the long-term viability of Florida mouse populations. Once management actions have been evaluated for effects on Florida mice, it will be important to ensure that management activities developed for scrub and sandhill also consider the habitat requirements of Florida mouse populations.

Management activities directly influence the composition of the habitat. Fire is the most universally applied management activity. However, in some cases mechanical treatments such as roller chopping or logging are used to restore degraded habitats ([Figure 5](#)). Mechanical treatments are utilized at times as substitutes for fire.



Figure 5. Logging (left) and roller chopping (right) are common mechanical habitat management treatments used in scrub. Photographs by Travis Blunden.

In both sandhill (Jones 1990, Layne 1990) and scrub (Layne 1990), Florida mice reach maximum abundance in the early post-burn stages and decline in the absence of fire. Evidence suggests that in scrub, Florida mice temporarily vacate areas where high intensity fires have consumed nearly all above-ground biomass, removing cover and food sources (T. Blunden, FWC, unpublished data). The longer-term effects of high intensity fires in scrub and of mechanical treatments are unknown. To assess the impacts of management, researchers could select a subset of sites with varying management treatments and monitor the response of the Florida mouse to these treatments over time. Developing a rigorous approach may require additional input from statisticians and land managers.



Figure 6. A high-intensity fire in scrub (left) and a low-intensity fire in sandhill (right). Photographs by Travis Blunden (left) and Chris Tucker, FWC (right).

Unrecognized degradation of available habitat is preventable by utilizing management targets. Management targets should be based on beneficial vegetative composition, vegetative diversity, or particular resources such as the abundance of mast-producing plant species.

Action 11 Identify and quantify habitat conditions that are favorable for the Florida mouse.

The Florida mouse is a commensal of the gopher tortoise (Jones 1990, Jones and Franz 1990, Layne 1990, 1992; Layne and Jackson 1994, Schmutz 1997). Florida mice almost exclusively use gopher tortoise burrows as sites within which to construct their burrows (Jones and Franz 1990, Layne 1992, Layne and Jackson 1994). Whether Florida mouse subpopulations are sustainable at sites where gopher tortoise densities are reduced is unknown. Florida mice are sometimes known to occur on sites where gopher tortoises are rare. However, we do not know whether these subpopulations remain viable on such sites. There is some evidence from Layne (1990, 1992) that Florida mouse populations are less dependent on the presence of gopher tortoise burrows in scrub than they are in sandhill sites. Recent studies using 3-dimensional ground-penetrating radar in sandhill revealed a complex burrow structure including abandoned tortoise burrows, rodent burrows, and insect burrows (Kinlaw and Grasmueck 2012). The same burrow systems are to be expected in scrub and may explain Florida mice habitat use in the absence of active tortoise burrows.

Other factors that can affect habitat suitability for the Florida mouse are not fully understood. The following components are thought to be important in determining habitat suitability:

- Diversity and height of midstory canopy
- Amount of herbaceous species
- Presence and density of acorn-bearing oak trees
- Presence and density of gopher tortoise burrows ([Figure 2](#))
- Diversity of ground cover
- Abundance of other mast-producing plants

Maintenance of habitat quality is a significant problem for Florida mouse conservation (Layne 1990). In many occupied sites, habitat quality has been degraded through a lack of effective management, as well as disturbance and fragmentation of existing habitat patches (Layne 1992).

Measurements of community structure and other approaches used to assess habitat quality are not necessarily independent. For example, the presence of oaks contributes to the structure and also to production of the acorn crop. In addition, other factors less directly correlated with the structure may affect habitat quality. For example, an increase in the diversity of ground cover plant species may significantly increase habitat quality for Florida mice but not affect the structure. If early successional sites support abundant Florida mouse populations (Layne 1990, 1992) and they are opportunistic feeders (Jones 1993), then plant species diversity and abundance of food items in their habitat may be important in determining habitat quality. In sandhill, a wide diversity of plant species may provide more reliable food resources across seasons, thus providing higher-quality habitat for Florida mice. However, further research is needed to determine whether high levels of plant diversity are a significant determinant of habitat quality for the Florida mouse ([Action 4](#) and [Action 10](#)). Once the characteristics of quality

habitat are quantified, habitat goals and management strategies that benefit the Florida mouse can be established.



Figure 7. Examples of Florida mouse habitat: scrub (left) and sandhill (right). Photographs by Terry Doonan, FWC.

Action 12 Identify potential sources of human-influenced mortality.

The impacts of human-influenced mortality on the Florida mouse are largely unknown. Increased densities of native predators that benefit from close association with people such as raccoons, opossums (*Didelphis virginiana*), and coyotes (*Canis latrans*) pose an increased threat. In addition, introduced predators such as the domestic cat and even imported red fire ants may increase the predation risks for Florida mice. The identification and minimization of these mortality risks would potentially benefit the Florida mouse and many other species.

Rule and Permitting Intent

The BRG found that the Florida mouse did not meet any criteria for listing and staff recommended removal from the Florida Endangered and Threatened Species List. However, the Florida mouse still faces threats from habitat loss, habitat degradation, and fragmentation. In order to meet the plan goal and prevent relisting of the Florida mouse, some protections are still needed.

Action 13 Remove the Florida mouse from the list of Species of Special Concern in Rule 68A-27.005, F.A.C., and implement the protections needed to address remaining threats.

Current Regulations and Permitting Structure

The Florida mouse is currently listed as a Species of Special Concern under Rule 68A-27.005, F.A.C., which regulates both intentional and incidental take. Take for listed species, as defined in Rule 68A-27.001(4), F.A.C. includes “harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in such conduct.” Intentional take usually occurs during research and monitoring activities, and is managed through the issuance of scientific collecting permits. Incidental take occurs during otherwise legal activities, such as development or land clearing. Although an incidental take permit is needed for activities that lead to take, very few of these permits are issued for Florida mice. The permitting standard identified in rule for Species of Special Concern is that permits are issued “upon reasonable conclusion that the permitted activity will not be detrimental to the survival potential of the species.”

Current Florida mouse protections must also be considered in the context of gopher tortoise management. The Gopher Tortoise Management Plan (relevant excerpts in [Appendix 1](#)) was recently revised to include a chapter on commensals, and the associated Gopher Tortoise Permitting Guidelines ([Appendix 2](#)) were amended to provide some limited guidance on the relocation of commensals during gopher tortoise relocations. Concerns about the humane release of Florida mice and the potential impacts to existing or recipient populations led to the development of temporary



Figure 8. Florida mouse tracks (small depressions in the sand), along with signs that the mice had recently excavated sand from the entrance of this abandoned gopher tortoise burrow. Photograph by Terry Doonan, FWC.

guidelines for Florida mice captured during gopher tortoise relocations. Under these guidelines, Florida mice can be captured incidentally during gopher tortoise burrow excavation, and no additional scientific collecting permit is needed to do this. If traps are set to target Florida mice capture, then a collecting permit is still needed. Mice captured incidentally during gopher tortoise relocations are to be released on site if any suitable habitat remains. Mice moved off-site can only be released at newly created habitats (i.e., reclaimed mine or quarry sites with no existing mouse populations) or provided to a facility for educational or research purposes (a scientific collecting permit would be needed by the receiving facility). The Gopher Tortoise Permitting Guidelines also state that species-specific guidelines for permitting and relocation need to be developed as part of management plans for listed commensal species (Florida mouse, Florida pine snake [*Pituophis melanoleucus mugitus*], and gopher frog [*Lithobates capito*]).

Proposed Protections and Permitting Intent

If removed from the Florida Endangered and Threatened Species List, the Florida mouse would have the existing protections outlined in the general prohibitions, Rule 68A-4.001, F.A.C., which states that “no wildlife or freshwater fish or their nests, eggs, young, homes or dens shall be taken, transported, stored, served, bought, sold, or possessed in any manner or quantity at any time except as specifically permitted by these rules nor shall anyone take, poison, store, buy, sell, possess or wantonly or willfully waste the same except as specifically permitted by these rules.” Take for general prohibitions is defined in Rule 68A-1.004, F.A.C., as “taking, attempting to take, pursuing, hunting, molesting, capturing, or killing any wildlife or freshwater fish, or their nests or eggs by any means whether or not such actions result in obtaining possession of such wildlife or freshwater fish or their nests or eggs.” Permits are issued through Rule 68A-9.002, F.A.C. for “scientific, educational, exhibition, propagation, management or other justifiable purposes,” although no permitting standard is provided.

Under these existing rules, a scientific collecting permit is still required for any activities that will directly capture or collect Florida mice, for mice maintained in captivity, or if relocations occur outside of permitted gopher tortoise relocations. Requiring a scientific collecting permit will allow FWC to assess the level of impact to Florida mice from research and monitoring activities, and coordinate with applicants on meeting research needs for Florida mice, particularly in acquiring genetic samples. Although no permitting standard is provided for issuing permits under general prohibitions, to meet this plan's goal, the standard should be that the permitted activity will not be detrimental to the survival potential of the species. In order to compile additional data regarding Florida mouse abundance and distribution, an additional condition should be added to scientific collecting permits: for other trapping efforts (e.g., herp arrays, gopher tortoise trapping, and other small-mammal surveys) within the Florida mouse's range, it should be required that FWC is notified when Florida mice are collected. Existing reporting conditions should be clarified to require the permittee to report to FWC specific information including date, location, and natural community type. Permit conditions also could require that if incidental mortality occurs, all Florida mouse specimens should be provided to FWC for genetic studies. This provision would allow FWC to gather additional data on Florida mouse populations.

Incidental take is not included in general prohibitions, but under the current SSC listing, this provision has rarely been applied for Florida mice. No permitting is proposed for incidental take of Florida mice on lands slated for development. However, keeping the Florida mouse from being relisted in the future is strongly dependent on the management of existing conservation lands. Activities such as some pinestraw operations or stumping activities proposed on conservation lands for potential economic benefit and which degrade habitat or have the potential to destroy burrows should require an additional level of review, since these activities may render important conservation lands unsuitable for Florida mice in the future. These activities on conservation lands may need incidental take permitting, mitigation, or assurance of absence for Florida mice as part of the resource use proposal. Any activities that might have a short-term impact but long-term benefit (such as prescribed fire and maintenance of fire lines) do not require an additional level of review. Activities without additional review also include other habitat management activities, agricultural activities (including silviculture) conducted in accordance with wildlife conservation measures adopted by the Florida Department of Agriculture and Consumer Services, and wildfire-suppression activities.

Because Florida mice rely on gopher tortoise burrows and the rules protecting burrows and gopher tortoises, the Florida mouse receives some indirect protection from incidental take during development and also benefits from land protection and habitat management for gopher tortoises. However, this protection is limited since Florida mice are found in a narrower range of natural communities than gopher tortoises and Florida mice will persist in burrows abandoned by gopher tortoises. Until recent revisions in the Gopher Tortoise Permitting Guidelines, Florida mice were relocated along with gopher tortoises, but no follow up monitoring was required to assess the success of these relocations or identify negative impacts to existing populations. Research and monitoring actions have been identified to address this data gap, and if research shows that Florida mouse populations are negatively impacted by the relocation of individuals ([Action 3](#)), then they should no longer be allowed, even in limited circumstances, under gopher tortoise

permits. Permitting guidelines for gopher tortoise relocations would need to be revised to remove provisions for moving Florida mice.

Additional Rule Conflicts and Intent

Two other rules may have unintended consequences for the protection of Florida mice, once it is removed from the list of Species of Special Concern. The Captive Wildlife Rule, 68A-6.0022, F.A.C., provides an exemption from permitting for the possession rats and mice. As a Species of Special Concern, the Florida mouse (and all other listed species) was not exempt within this rule. However, if removed from the protected species list, there may be confusion about the potential to possess Florida mice. The intent in rule should be that possession of Florida mice will require a scientific collecting permit, and clarification may be needed for the Captive Wildlife Rule.

The Nuisance Wildlife Rule 68A-9.010, F.A.C., allows nuisance wildlife to be taken without a permit. Occasionally during development, when habitat loss occurs and burrows are collapsed within occupied habitat, Florida mice may temporarily move into structures or machinery (vehicles, tractors, etc.) to nest, particularly if no remaining burrows are available (M. Tucker, FWC, personal communication). The nuisance rule does not authorize the take of listed species; however, once removed from the list of SSC, Florida mice may be taken as a nuisance species. Although this form of take is believed to be relatively low (and occurs in areas that are already impacted), it would be beneficial to develop a reporting mechanism (potentially within the gopher tortoise permitting guidelines) to report Florida mice using structures during or after development. This would help FWC to better assess the level of threat from take under the nuisance rule.

One additional concern is that the rules for Florida mice (and other non-game mammals) are spread throughout Division 68A, F.A.C., which makes it difficult to follow the intent and needed protections for species like the Florida mouse. Rules for Amphibians and Reptiles have been compiled into single chapters within Division 68A, F.A.C., and a similar chapter for non-game mammals would help alleviate the confusion that currently exists for these species.

Law Enforcement

FWC’s Division of Law Enforcement and law enforcement partners from other agencies are responsible for enforcing Florida’s wildlife and fisheries laws. Law enforcement is an essential component of the protections that are integral to achieving the goals and objectives of this plan (and other imperiled species’ plans).

Action 14 Implement a training program to provide information to FWC and other law enforcement officers on the identification of and rules pertaining to the Florida mouse in conjunction with the gopher tortoise and other commensals.

Officers on the ground not only ensure the enforcement of conservation laws, but also educate the public on how to identify and report violations. FWC species experts and land managers, in coordination with other partners, can provide appropriate information to law enforcement officers. As a gopher tortoise commensal, officers involved with tortoise situations are most likely to encounter Florida mice. For this reason, the Florida mouse and other commensals should be included as a portion of any training concerning tortoise protections and relocation.

Information also could be made available online as electronic training modules when appropriate. This information will enable officers to accurately identify Florida's protected species, to be aware of applicable rules and regulations pertaining to these species, and to better explain to the public the ecological importance of Florida's non-game species.

Coordination with Division of Law Enforcement and other law enforcement agencies is necessary so law enforcement personnel are aware of the information and reasons for its distribution. The information could be provided in 30- to 60-minute modules that could be readily incorporated into planned meetings (e.g., Captain's meetings) or during planned in-service training workshops. Information also could be made available online as electronic training modules when appropriate.

Incentives and Influencing

This plan provides recommendations for methods for increased involvement of partners and stakeholders in management activities that maximize conservation benefits for this species. Implementation of this plan will require the cooperation of many agencies and partners outside of FWC.

Action 15 Develop or enhance existing incentive programs to encourage implementation of habitat management practices consistent with habitat management guidelines to benefit the Florida mouse on public and private lands.

Encouraging managers of conservation lands to focus on the Florida mouse when developing and implementing land management plans is an essential component of effective species conservation. Habitat management that emphasizes maintaining or improving habitat quality for the Florida mouse on public and private conservation lands is essential to keep the Florida mouse off the Florida Endangered and Threatened Species List.

Efforts to inform land managers about the habitat needs of the Florida mouse are important ([Action 1](#)). Encouraging management that will support a viable Florida mouse population should follow these efforts ([Action 10](#)). When possible, managers of lands such as Department of Defense facilities that are not managed specifically for resource conservation should be encouraged or provided incentives to increase benefits for Florida mouse populations.

Almost half of potential Florida mouse habitat is on private lands (Endries et al. 2009). Encouraging appropriate habitat management on these lands through technical assistance and financial support will help ensure the long-term survival of this species. FWC's Landowner Assistance Program (LAP) and other state and federal programs provide technical and financial assistance to private landowners who conduct wildlife management practices on their lands. Species experts will coordinate with the LAP and other landowner assistance programs to identify private landowners interested in restoring natural communities to benefit the Florida mouse and other wildlife.

Education and Outreach

The public is unlikely to encounter the elusive Florida mouse; therefore, linking the Florida mouse to other, more charismatic species that inhabit the same natural communities may be the most successful outreach strategy. The gopher tortoise is the most fitting, as the Florida mouse is a well-known commensal and its life history is directly linked to the tortoise. Outreach could be made in conjunction with other commensals such as the gopher frog. Other opportunities may include outreach concerning scrub and sandhill conservation or the Florida scrub-jay. Information and photographs should be included in publications such as press releases, social media, and other materials available to the public.

Action 16 Develop and distribute educational materials that include information on the range, natural history, and threats of the Florida mouse.

Coordination with Other Entities

No specific actions have been identified for this section; however, many actions in this plan will require coordination between multiple agencies, universities, and other organizations. Florida has a number of academic institutions and researchers capable of assisting with the research and monitoring activities described in this plan. [Action 14](#) in the [Law Enforcement](#) section and [Action 15](#) in the [Incentives and Influencing](#) section also will require effective coordination across many agencies and organizations.

Successful implementation of the habitat conservation and management measures ([Action 10](#)) called for in this plan will require coordination and partnership among the many public and private land managers responsible for supporting sandhill and scrub across the range of the Florida mouse. It will be necessary for land managers to apply appropriate management practices and to enhance habitat conditions that maximize benefits for the Florida mouse.

Land managers, species experts, and other specialists should meet regularly to discuss management issues and share ideas for improving management to benefit the Florida mouse and other wildlife species dependent upon these upland communities. Informal partnerships, such as the Upland Working Groups, provide a forum for such interactions and should be supported where they exist.

Overall, active coordination across agencies is essential if Florida is to ensure long-term persistence and viability of Florida mouse populations. Management for the Florida mouse on state and other public conservation lands will be essential for successful conservation of this species. In addition, management for the Florida mouse across all state conservation lands benefits a vast array of other native species.

Floridians have ecological, legal, and economic reasons to manage rare and declining species on state conservation lands. Species like the Florida mouse face increasing threats due to the continued growth of the human population, the land alterations that accompany this growth, and the potential for negative impacts due to climate change. Considering this, management and restoration should be a higher priority on all state conservation lands.

CONSERVATION ACTIONS

Public conservation lands may be the best hope for conservation of the Florida mouse. Managed public conservation lands must play a prominent role in the long-term maintenance and expansion of a viable Florida mouse population. Successful conservation of the Florida mouse will depend to a large extent on the success of Florida mouse populations on public conservation lands. This is not an unreasonable expectation. With sound ecosystem management combined when necessary with focused species management, managers can successfully sustain and increase populations.

Table 1. Florida Mouse (*Podomys floridanus*) Conservation Action Table

NOTE: An explanation of acronyms used is below the table.

Objective(s) Addressed	Team Assigned Priority Level	Action Item Number	Action Items	Conservation Action Category	Ongoing, Expanded or New Effort?	Authority	Man Power	Estimated Cost To Implement	Funding Source(s)	Lead for Implementation: FWC Program(s) and/or Section(s)	External partners	Likely Effectiveness	Feasibility	Urgent?
2	1	1	Manage conservation lands with suitable habitat for the Florida mouse to promote a stable gopher tortoise population and a mosaic of conditions that includes a diversity of plants, including oaks.	Habitat Conservation & Mgmt	NEW	YES	YES	TBD	Existing Budget	WHM	Land management agencies, WMDs, FFS, FPS	High - Many conservation lands already manage the land in a way that is appropriate for the Florida mouse.	Feasible.	No, this will help enhance suitable habitat but is not currently a critical need.
1	2	2	Maintain functional metapopulations of Florida mice.	Habitat Conservation & Mgmt	NEW	YES	YES	TBD	Unknown	FWRI, SCP	Universities	Moderate - smaller population may be important in portions of their range with a high degree of fragmentation.	Feasible. Much of this can be accomplished remotely.	NO
1	1	3	Determine whether relocation is an effective conservation strategy for the Florida mouse.	Monitoring & Research	NEW	YES	YES	\$0-25k	Unknown	FWRI, SCP	Universities	High - translocation already occur and it is unclear if they are beneficial.	Feasible once other research has been completed.	NO
1	1	4	Develop and implement a survey protocol for determining presence of Florida mice on conservation lands.	Monitoring & Research	EXPANDED	YES	YES	\$0-25k	Existing Budget	WHM, FWRI, UERP	Land management agencies, WMDs, FFS, FPS	High - With a standard protocol in place land managers can determine if they are present on conservation lands.	Highly feasible. Draft protocols already exist and have been implemented on some sites.	NO
1	2	5	Develop predictive population models using optimal density estimates for Florida mice in each primary habitat type (i.e., sandhill, scrub, and scrubby flatwoods).	Monitoring & Research	NEW	YES	YES	TBD	Unknown	WHM, FWRI	Universities	High - With density estimates and presence/absence surveys estimates of population sizes are a possibility.	Moderately feasible. A better predictive population model will need a lot of data.	NO
1	2	6	Initiate a monitoring program for the Florida mouse on public lands.	Monitoring & Research	EXPANDED	YES	NO	TBD	Unknown	WHM, FWRI, UERP	Land management agencies, WMDs, FFS, FPS	High - Monitoring is the only way to know the status and trends of the species	Feasible. A simple protocol for presence on many lands and reference site density estimates are easily obtainable.	NO
3	1	7	Identify unique phylogeographic lineages within the overall statewide population and the geographic extent of each lineage.	Monitoring & Research	ONGOING	YES	YES	TBD	Unknown	WHM, FWRI, or SCP	University of Florida	High - This action will determine if the entire population should be treated as one continuous population or if there are subunits within.	Feasible. Dr. Austin at UF has already begun this work. FWC can assist in obtaining samples from across the range.	NO
1	2	8	Within each of the 5 major ridge systems, determine an estimate of population size and whether it is stable, increasing, or declining.	Monitoring & Research	NEW	YES	YES	TBD	Unknown	WHM, FWRI	Universities	High - Once Action 5 is completed this should be a logical next step.	Moderate. Population size and trends can be labor intensive.	NO
1	2	9	If the statewide population or any subpopulation is declining, investigate the causes of that decline and implement activities to counter population declines.	Monitoring & Research	NEW	YES	NO	TBD	Unknown	WHM, FWRI	Land management agencies, WMDs, FFS, FPS	Moderate - This actions is dependent on results from other actions.	Moderate/low. This action requires first monitoring, then making management recommendations that are in part, unknown at this time.	NO
2	2	10	Determine how current management practices (including fire) of scrub and sandhill impact Florida mouse populations.	Monitoring & Research	NEW	YES	NO	TBD	Unknown	WHM, FWRI	Universities, WMDs, FFS, FPS	Moderate - effects of management practices are difficult to pinpoint in naturally fluctuating populations	Moderate. This may take some time and effort but should be worthwhile.	NO
2	1	11	Identify and quantify habitat conditions that are favorable for the Florida mouse.	Habitat Conservation & Mgmt	NEW	YES	NO	TBD	Unknown	WHM, FWRI, LAP	Universities	High - knowing the favorable habitat characteristics will give land managers ways to benefit populations.	Feasible. However this could be labor intensive.	NO
1	2	12	Identify potential sources of human influenced mortality.	Monitoring & Research	NEW	YES	NO	TBD	Unknown	FWRI, SCP	Universities	Moderate. The impacts of human cause mortality are unknown.	Difficult. It will be hard to identify mortality in such a small species.	NO

Table 1. Florida Mouse (*Podomys floridanus*) Conservation Action Table

Objective(s) Addressed	Team Assigned Priority Level	Action Item Number	Action Items	Conservation Action Category	Ongoing, Expanded or New Effort?	Authority	Man Power	Estimated Cost To Implement	Funding Source(s)	Lead for Implementation: FWC Program(s) and/or Section(s)	External partners	Likely Effectiveness	Feasibility	Urgent?
1	5	13	Remove the Florida mouse from the list of Species of Special Concern in rule 68A-27.005, F.A.C. and implement the protections needed to address remaining threats.	Protections & Permitting	NEW	YES	YES	\$0-25k	NA	NA	NA	NA	NA	NO
1	3	14	Implement a training program to provide information to FWC and other law enforcement officers on the identification of and rules pertaining to the Florida mouse in conjunction with the gopher tortoise and other commensals.	Law Enforcement	NEW	YES	YES	\$0-25k	Unknown	SCP, LE	None	Low. LE will most likely not deal with Florida mice unless in conjunction with tortoise issues.	Feasible. Could be combined with tortoise training.	NO
2	3	15	Develop or enhance existing incentive programs to encourage implementation of habitat management practices that are consistent with habitat management guidelines that benefit the Florida mouse on public and private lands.	Incentives & Influencing	NEW	YES	YES	TBD	Unknown	SCP, LAP	USFWS, FFS, WMD	Moderate. This will be more difficult once it is taken off the state imperiled species list. Should work with gopher tortoise program on this.	Feasible. There is probably more potential for work on public conservation lands.	NO
1	3	16	Develop and distribute educational materials that include the range, natural history and threats of the Florida mouse.	Education & Outreach	NEW	YES	YES	\$0-25k	Unknown	OPAWVS, SCP	Universities	Moderate. The Florida mouse could be charismatic, however education is the only way the public will encounter this species.	Highly feasible. There are already programs and opportunity within FWC now.	NO

Acronyms used in this table:

F.A.C. Florida Administrative Code
 FFS: Florida Forest Service
 FPS: Florida Park Service
 FWC: Florida Fish and Wildlife Conservation Commission
 FWRI: Fish and Wildlife Research Institute, the research branch of the Florida Fish and Wildlife Conservation Commission
 LAP: Landowner Assistance Program, a program within the Office of Conservation Planning services within the Habitat and Species Conservation section of FWC
 LE: Law enforcement
 OPAWVS: Office of Public Access and Wildlife Viewing Services, administered by the Florida Fish and Wildlife Conservation Commission
 SCP: Species Conservation Planning, a Section of the Florida Fish and Wildlife Conservation Commission's Division of Habitat and Species Conservation
 UERP: Upland Ecosystem Restoration Project
 USFWS: United States Fish and Wildlife Service
 WHM: Wildlife and Habitat Management, a Section of the Florida Fish and Wildlife Conservation Commission's Division of Habitat and Species Conservation
 WMD: Water Management District(s)

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APPENDICES

Appendix 1. Information about the Florida mouse, relevant to this plan, that is included in Chapter 5 of the FWC Gopher Tortoise Management Plan 2012 (Gopher Tortoise Commensal Species).

Biology

Commensal Ecology

The ecology of the Florida mouse is closely tied to the gopher tortoise. Dependence by Florida mice on gopher tortoise burrows as sites for excavation of their burrows (Jones and Layne 1993) leaves this species vulnerable to loss or decline of gopher tortoises. The gopher tortoise burrow provides shelter and protection during dispersal and from fire and adverse weather conditions (Layne 1990). The Florida mouse can be sensitive to cold temperatures and begins to show signs of cold stress at 50°F (10°C; Jones 1990). Florida mice typically construct their burrows as small, U-shaped, tunnels off the sides of the main gopher tortoise burrow. Florida mouse burrows also serve as nesting sites, with expanded nesting chambers usually present (Layne and Jackson 1994).

Considerations for Limited Relocation of Florida Mice

Limited relocation may be authorized by FWC in concert with permitted gopher tortoise relocation activities and specified on the gopher tortoise relocation permit. This is because Florida mice can be opportunistically captured by hand during burrow excavation. Mice can be retained and transported in Sherman traps or small animal carriers for 24 hours, as long as they are carefully protected from extremes of heat and cold. Sunflower seeds should be provided. Mice should be released at the mouth of gopher tortoise burrows at the relocation site. To maximize relocation success, mice should be released into active burrows of adult gopher tortoises. Only 1 mouse should be released per burrow, unless mice were captured at the same burrow at the recipient site. Florida mice should not be released at any site with an existing population of Florida mice. Florida mice should be released only within their known geographic range and, more specifically, recipient sites (such as reclaimed quarries) should lie within the same ridge system to avoid movement of mice across potential geographic boundaries for subpopulations. The maximum dispersal distance for Florida mice is not well known, so suitable patches of xeric upland habitat should not be separated by more than 1 km (0.6 mi) to maximize the probability that Florida mice would be able to move successfully among patches.

Conservation and Research Actions

Determine the genetic variation of the Florida mouse across its range to identify the potential presence of subpopulations.

The degree of genetic flow between the suspected subpopulations (i.e., Ocala, Atlantic Coastal Ridge [ACR], Lake Wales Ridge [LWR], and Brooksville Ridge) is unknown. Understanding genetic variation is especially needed in areas where habitat is fragmented (ACR and LWR). Some understanding of genetic connectivity would be required before relocation could be used as a possible management tool.

Determine whether relocation is an effective conservation strategy for the Florida mouse.
No relocation guidance has been developed for the Florida mouse. Research is necessary to determine if relocation is appropriate for this species. If experimental relocations indicate that relocation is a viable strategy for this species, further research should be conducted to determine the most effective relocation method for Florida mice.

Monitor relocated Florida mice to assess the survivorship of those individuals and the effects of existing populations of Florida mice and habitat conditions on the success of relocation.

Little is known about the effects of relocation on Florida mice. Relocation of *Peromyscus polionotus* spp. indicates that juveniles may survive better than adults, and that movement of animals into existing populations reduces survival of resident individuals (J. Gore, FWC, personal communication; Van Zant and Wooten 2003). Research is needed to:

- Determine impacts to existing populations of Florida mice.
- Determine if presence of existing tortoise burrows and other habitat conditions affect survival of relocated mice.
- Determine a minimum number of individuals that should be relocated to generate a viable population and avoid founder effects.
- Determine whether age class affects survivorship of individuals that are relocated.

Appendix 2. Information about Florida mouse relocation included in the FWC Gopher Tortoise Permitting Guidelines 2013.

Interim FWC Policy on the Relocation of Priority Commensals

The FWC has permitted the humane relocation of gopher tortoises since the mid-1980s. Along with the gopher tortoise, a “suite of species,” or commensals, was also permitted for relocation. Specifically, state-listed species were authorized for relocation with the gopher tortoises when captured incidentally during authorized gopher tortoise capture methods. These state-listed species included the Florida mouse, gopher frog, and pine snake; and prior to 2009, also included the eastern indigo snake. Although the relocation of these animals has occurred, no follow-up monitoring was required. Therefore, little to nothing is known about the survival of these relocated animals and their impact on resident individuals or populations.

Furthermore, little is known about how commensal species respond to relocation, in particular the Florida mouse, gopher frog, and pine snake, and little research has been conducted on the best methods for relocating these species. Concerns exist about the potential impacts to resident populations, genetic boundaries, and minimizing the potential spread of disease because these factors are poorly understood. For these reasons, interim guidelines for limited relocation are provided until the individual species management plans are developed and approved by FWC’s Commission. Once the species plans are approved, this interim guidance will be re-evaluated to ensure that all aspects of commensal conservation are considered, and changes to this policy will be amended in the future as needed. The FWC will work with stakeholders from the Gopher Tortoise Technical Assistance Group and species experts from scientific and academic communities to develop guidance best for species conservation while ensuring its practicability for the regulated community.

Until more permanent guidance is developed and approved by FWC’s Commission, the priority commensals that do not require a separate permit from FWC or the U.S. Fish and Wildlife Service will be authorized for limited relocation under FWC-issued gopher tortoise relocation permits. The FWC gopher tortoise permits do not authorize release of any animal onto properties not specified in the issued permit. One type of gopher tortoise relocation permit for temporary exclusion does allow gopher tortoises to be temporarily relocated to adjacent sites only with written permission from the landowner. This written permission must be included with the permit application in order to obtain FWC authorizations needed for relocation on adjacent habitat. Species that will be authorized include the Florida mouse, gopher frog, and pine snake. No other species will be authorized for limited relocation under gopher tortoise permits, and a separate permit may be needed in order to perform relocation. Upon approval of the Gopher Tortoise Management Plan at the scheduled 5 September 2012 FWC Commission meeting, this *Interim FWC Policy on the Relocation of Priority Commensals* will supersede the guidelines for commensals provided in Appendix 9, *Handling of Commensal Species during Relocations* of the Gopher Tortoise Permitting Guidelines (April 2008, revised November 2011).

Limited Relocation Guidance

Limited relocation helps remove captured commensals from harms’ way while minimizing the threats to individuals and populations (e.g., by lessening potential impacts of competition with resident populations, crossing genetic boundaries, and possible spread of disease). Different permit options are available for the relocation of gopher tortoises depending on the type and extent of impact to the gopher tortoise and habitat on which it depends. Gopher tortoise relocation permits are described in the Gopher Tortoise Permitting Guidelines (April 2008, as amended) available at

www.MyFWC.com/GopherTortoise. The following interim guidance only applies to listed and non-listed commensals that are incidentally captured during permitted gopher tortoise relocation activities. Trapping or capturing these species associated with any other activity requires a separate permit from FWC's Protected Species Permitting section.

To accommodate various project types and permit scenarios, FWC has developed interim guidance (see [Table A](#)) for limited relocation of commensals based on post-development site characteristics and species identity. Additional species-specific considerations for relocations are included above in the sections for priority commensal species. Species-specific guidelines for permitting relocations and research are forthcoming and will be developed as management plans are finalized for listed commensal species. For the interim, the following guidance is provided so that animals encountered during gopher tortoise trapping and relocation efforts are appropriately handled and released.

Table A. Interim guidance for limited relocation of commensals based on post-development site characteristics and species identity.

Post-development site characteristics	If a gopher tortoise burrow will be impacted from development activities and some habitat will remain on-site.	If a gopher tortoise burrow will be impacted from development activities and adjacent habitat is available.	If a gopher tortoise burrow will be impacted/destroyed from development activities and no habitat will remain.
Florida Mouse	Any incidentally captured Florida mouse should be released on-site or allowed to escape unharmed if some habitat will remain post-development activities.	Any incidentally captured Florida mouse should be released on-site as close to original habitat as possible.	Any incidentally captured Florida mouse should be allowed to escape unharmed, relocated offsite to newly created (i.e., reclaimed) habitat that is not currently occupied by Florida mice, or donated to a facility for educational or research purposes (permit required for receiving facility).

Appendix 3. WCPR Florida mouse survey protocol (draft).

FWC Terrestrial Habitat Conservation and Restoration
Wildlife Conservation, Prioritization, and Recovery Program

Standard Monitoring Protocol for Florida Mouse (*Podomys floridanus*) Occupancy Surveys

Purpose

The purpose of this monitoring protocol is to determine occupancy and general spatial distribution of Florida mouse within potential habitat patches on Wildlife Management Areas (WMAs) throughout the state of Florida. This monitoring will not provide density, abundance, or other population estimates for determination of changes in population over time. This protocol does include estimates of detection probability to allow managers to estimate the actual number of habitat patches (including some patches with no trapped mice) containing Florida mice. This protocol will allow managers to periodically confirm that Florida mice remain on an area, examine spatial distribution of Florida mice on the WMA, and document presence of this species to a unit once restoration activities have occurred.

Seasonality

Trapping for Florida mouse should occur during November March to reduce the likelihood of heat stress on capture individuals. When nighttime temperatures are forecast to be less than 15.5° C (60° F), a small ball (i.e., slightly smaller than a tennis ball) of cotton or polyester fiber-fill should be placed in the back of each trap for insulation. Trapping should not occur when nighttime temperatures are forecast to be less than 7.2 ° C (45° F) whenever possible. Trapping should be discontinued during periods of heavy or persistent rainfall.

Repetition

An initial baseline survey using this protocol should be completed as soon as possible once an individual WMA determines there is the need to monitor the status of Florida mouse. After this initial survey, the recommendation is to repeat the effort on a 5-year basis, pending resource availability. If no Florida mice are detected anywhere on a WMA after two repetitions of this survey (10 years), surveys can be discontinued.

Suggested Equipment

Sherman small-mammal traps (8 x 9 x 23 cm [3 x 3.5 x 9 in]), cotton pillowcase (for handling captured mice), gloves, datasheets on write-in-the-rain paper, pencil, bait (stored in cardboard Quaker oats container), global positioning system unit, flagging tape, measuring tape (with meter increments).

Protocol

Habitat Patch Selection

Florida mice primarily occur in scrub, scrubby flatwoods, sandhills, upland oak and hardwood hammocks, and disturbed or ruderal habitats containing xeric soils. Areas that contain a cluster or colony of active and inactive gopher tortoise burrows have the best potential to be occupied by Florida mice. Using the WMA's potential habitat map for Florida mouse (or another technique if

this has not been completed), all patches of potential Florida mouse habitat should be identified and prioritized for surveying. Patches of habitat that are contiguous but divided by artificial means (i.e., roads, firebreaks, etc.) or narrow bands of unsuitable habitat (e.g., a small creek, hammock, or cypress strand) should be treated as a single patch of habitat and surveyed accordingly. Habitat patches to be surveyed should be identified by the management unit that contains the largest amount of acreage within the patch (i.e., a surveyed patch with 75% of its area within management unit 15 would be *Habitat Patch 15*).

Surveys should focus on trapping within the largest habitat patches within a particular WMA. Patches of greater size (> 8 ha [20 ac]) have the best potential to hold a resident population of Florida mice and should be preferred over smaller, isolated pieces. Smaller, isolated patches may contain Florida mice but presence of mice here may be highly variable. Focusing on the largest habitat patches will increase the likelihood of detecting mice if they are present and provide more reliable long-term information about the presence of the species on an a WMA. If extra resources are available (or if potential habitat patches are less than 8 ha [20 ac]), trapping in small patches may be useful for determining how these isolated areas function to connect larger patches of habitat.

Trapping Design

When surveys occur within habitat patches containing gopher tortoise burrows, trapping stations should be placed within 1 m (3.2 ft) of a burrow to increase likelihood of capture. Trapping stations should be well distributed throughout the habitat patch near tortoise burrows with a frequency of 10 stations (20 traps) per 8 ha (20 ac) of habitat. Some trapping stations may be placed along the edges of roads and firebreaks where tortoise burrows often occur, but effort should be made to also put stations around burrows within the interior of the habitat patch. Trapping stations may be placed randomly within the habitat patch if there are not enough burrows present.

When surveys occur within habitat patches not known to contain gopher tortoise burrows, transects are recommended. Transects should be run with a frequency of 10 trapping stations (20 traps) per 8 ha (20 ac) of habitat. When using transects, a spacing of 15 m (50 ft) between trapping stations is recommended. A transect of 10 trapping stations placed every 15 m (50 ft) will cover a sampling area of 2,250 m² (0.55 ac). Portions of each transect can be run parallel to a road or firebreak edge (about 1 to 2 m [3.2 to 6.5 ft] into the habitat patch), but a portion of the transect (at least 50%) should also turn 90° into the habitat patch's interior. Placement of some traps along edges should reduce total survey time for surveyors because it will be easier to locate, check, and remove traps. The beginning, end, and any 90° turns within each transect should be recorded with a global positioning system unit. Each trapping station should be marked with flagging tape for easy identification.

Trap placement

Two traps should be placed at each trapping station. Traps at each station should be placed within one meter of the flagging tape, and be placed near stumps, fallen logs, gopher tortoise burrows, or pathways whenever possible. To increase the likelihood of capturing Florida mice, traps should be placed under shrubs or logs to maximize cover. If possible, traps should be placed on the west side of cover to maximize the amount of shade available throughout the day.

All traps should be labeled with identification of ownership (i.e., Wildlife Management Area name, or FWC).

Running the Traps

Within each habitat patch, traps should be placed at stations on Monday afternoon and checked on each consecutive morning, if needed, for up to 4 nights, and traps checked or removed on Friday. Each trap night is considered a separate sampling period for the overall habitat patch and should be recorded as a “0” if no mice are detected and a “1” if a mouse is captured in any trap. If a mouse is detected after the first night of trapping (i.e., Tuesday morning), these traps should be left out for only 1 more evening in order to record another sampling period. After that second night, traps should be removed. If mice are first detected after the second or third night of trapping, traps should be removed and placed in a new habitat patch. Trapping habitat patches in this manner will give the following options in sampling histories;

0,0,0,0	Mice are never detected during the entire week of trapping.
0,0,0,1	Mice are detected on Friday (after 4 nights of trapping)
0,0,1	Mice are detected on Thursday (after 3 nights of trapping)
0,1	Mice are detected on Wednesday (after 2 nights of trapping)
1,0	Mice are detected on Tuesday (1 night of trapping), and NOT detected on Wednesday
1,1	Mice are detected on Tuesday (1 night of trapping), and detected again on Wednesday

Information from trapping in this manner will be used to “calibrate” the survey results based on detection probability to estimate how much of the WMA’s potential habitat patches are actually occupied after correcting for areas that did not catch mice but actually contain Florida mice. This is important because it is not possible to accurately conclude that a habitat patch is absence of mice simply because none are captured during the one-week trapping effort. Mice during the trapping session may have avoided the traps, or not been active due to other environmental factors. Unfortunately, it will not provide information on which specific habitat patches did not trap mice but are actually occupied. However, over time, it will provide general trend information about the proportion of habitat patches containing mice that can be used as an index of the status of Florida mice on the WMA.

Traps should be baited with a mixture of seeds (e.g., sunflower seeds), grains (e.g., crimped oats or scratch grain), and rolled oats. **DO NOT USE PEANUT BUTTER OR FRUIT.** Avoid placing traps in areas where fire ants are likely to enter, and traps should be moved whenever fire ants are present. If fire ants are in a trap, the trap should be moved to new location and cleaned of ants. If ants continue to be a problem, the trap should be closed to prevent mortality. Traps should be set in the late afternoon, and all mice **RELEASED** by 2 hours after sunrise the following morning. During a trapping session, traps should remain closed during the day, and reset late in the afternoon to minimize captures (and mortality) during the day. To reduce the occurrence of fire ants in traps, traps can be closed and placed in oaks/shrubs above the ground during the day.

All traps should be visually inspected before closing to assure no small mammals are accidentally left in the trap. Captured mice and other native small mammals should be released at the point of capture. Exotic species (i.e., house mice) should not be released back into habitat.

When the survey is complete, all traps should be thoroughly cleaned using water to remove bait, feces, and other material within the trap. After this cleaning, traps should be placed in a diluted bleach solution (i.e., one capful per gallon of water) for 10 to 15 minutes to further sanitize them. After resting in the bleach solution, traps should be rinsed one more time with water. Traps should be allowed to air dry before being placed back into storage.

Data Collection:

Trapping data should record the total number of Florida mice captured during the trapping session and all other species captured. As mentioned above, a “1” or “0” should be recorded for each night during the trapping session depending on whether or not mice were captured. Enter a into the datasheet if there was no need to trap during those nights (i.e., if mice are detected after the first trap night). Data should be entered into the provided datasheet.

Data Summarization:

At the end of the complete survey, the following information should be recorded;

1. Number of habitat patches (and their respective acreage) surveyed for Florida mice & number of management units with presence of Florida mice
2. Total acreage of suitable habitat surveyed for Florida mice and total acreage with presence of Florida mice
3. Total number of Florida mice captured
4. Inventory of other small mammals captured during the survey